

Ecology Notes Packet for PreAP Biology

Ecology (oikos mean home) is the scientific study of interactions between organisms and their environments. Ecologists study the Organism's behavior, Population of organisms in the environment, Communities the organisms live in, Ecosystem or the interaction of all the abiotic and biotic factors, and Biosphere or all the parts of the Earth that support life

Niche is the role a species plays in a community

Habitat is the place where an organism lives its life

Population is a group of individuals of the same species living in a particular geographic area.

Community consists of all the organisms of all the species that inhabit a particular area

Ecosystem is composed of all the abiotic factors and biotic factors

Abiotic factor – non-living parts such as air currents, temperature, moisture, wind and light

Biotic factor – living parts of the environment

Communities:

Limiting factor in a community is any abiotic or biotic factor that restricts organism's reproduction, existence, population size or movement.

Tolerance is the ability of an organism to withstand fluctuations in biotic and abiotic factors.

Succession is the orderly, natural changes that occur in an environment. (See below)

Climax community is a stable, mature community that does not change or have very little change.

Biomes – A large group of ecosystems that share the same type of climax community.

Marine Biomes –

Photic zone – part of the marine biome that sunlight penetrates

Aphotic zone – part of the marine biome that sunlight cannot penetrate

Benthic zone – bottom of all aquatic biomes. Made up of sand and organic/inorganic sediments. Major food source is dead organic matter (**Detritus**)

Estuary – is the coastal body of water where freshwater and salt water mix

Intertidal zone – the portion of the shore line that lies between high and low tide.

Freshwater biome – lakes, ponds and rivers

Tundra – treeless biome that circles the north and the South Pole where the temperature never rises above freezing. **Permafrost** is ground that is permanently frozen.

Taiga – (Coniferous forest) – trees are all conifers and the temperature is warmer than that of Tundra, but is still very low. Rainfall between 20 and 40 inches per year.

Desert – Arid (dry) region with sparse plant life. Rainfall is less than 20 inches per year. Great variation in temperature (-30°C to 50°C). Common desert animals include snakes, lizards, scorpions, ants, beetles. Water conservation is important.

Savanna – warm year round. Rainfall between 10 and 20 inches per year. Dry season can last up to 8 or 9 months. Has scattered trees that are often thorny and have small leaves.

Fires are common. Large herbivores such as wildebeests and zebras.

Grasslands – Land is dominated by grasses, very few trees or shrubs. Rainfall 20 to 50 inches per year

Temperate Forests – Broad-leafed deciduous trees are dominate. Rainfall is 30 to 60 inches per year. Temperature varies between below freezing to 100°F.

Tropical Rain Forest – found on the equator of Earth. Very warm, very wet. Temperatures remain around 80° F with an average of 80 inches of rain per year. Animal diversity is the highest in this biome than any other terrestrial biome

Carrying Capacity is the maximum population size that a particular environment can support. It is not fixed, but can change over time due to limiting factors such as energy, shelters, refuges from predators, soil nutrients, water, and nesting sites.

Disturbance is an event such as a storm, fire, flood, drought, or human activity that changes a community, removes organisms from the community and alters resources availability.

Ecological Succession -

Primary Succession - growth where no growth was before, virtually lifeless area where soil has not yet formed. Example could be a new volcanic island or the rubble left behind by a retreating glacier. Usually the only life left is prokaryotic (bacteria)

Mosses and lichens are usually the first organisms to colonize the area (and are photosynthetic). Then soil develops gradually as organic matter accumulates.

Once soil is present – mosses and lichens are usually overgrown by grasses, shrubs and trees – plants become dominant. This process may take hundreds or thousands of years.

Secondary Succession – occurs when an existing community has been cleared by some disturbance that leaves the soil intact. Examples: Fire destroying Yellowstone or a forested area cleared for farming and then abandoned. Earliest plants are usually herbaceous species (green stemmed plants), then woody shrubs and eventually forest return.

Special relationships between organisms or Symbiosis:

Commensalism – one organism benefits, the other organism is neither harmed nor benefited in the relationship.

Mutualism – both organisms benefit from the relationship.

Parasitism – one organism benefits at the expense of the other organism

Trophic Level is the position an organism occupies on the food web.

Food chain - path of food (energy). It is the transfer of energy up the trophic levels.

Food web is an interconnected path of energy. Ecosystems have potential energy in fat (Animals), in the chemical bonds of leaves. Every time energy is transferred in the food web heat is generated and maybe lost.

Pyramid of numbers - It is a pyramid constructed on the basis of number of individuals that occupy each trophic level in a given area of the ecosystem, at a given period of time.

Organisms can be:

Autotrophic – make their own food

Heterotrophic – get their food. There are several types of heterotrophs

Carnivore, Herbivore, Omnivore, Scavenger, Decomposer,

Detritivore (decomposes organic matter)

Trophic Relationships – Remember the primary source of energy on earth - Sun

Primary Producers - first organisms to capture the energy from the sun. They are autotrophs. **Primary Productivity** - The amount of material the photosynthetic organisms of an ecosystem produce.

Primary Consumers - eat primary producers. They are herbivores.

Secondary Consumers – eat primary consumers. They are carnivores

Tertiary Consumers – eat secondary consumers. They are carnivores.

Decomposers - Detritivores (Saprobies) are consumers which feed on dead organisms or organic wastes (non-living organic matter called detritus)

Water Cycle

Precipitation - Condensed water vapor that falls to the Earth's surface . Most precipitation occurs as rain, but also includes snow, hail, fog drip, and sleet.

Canopy interception The precipitation that is intercepted by plant foliage and eventually evaporates back to the atmosphere rather than falling to the ground.

Snowmelt - The runoff produced by melting snow.

Runoff - The variety of ways by which water moves across the land. This includes both surface runoff and channel runoff. As it flows, the water may seep into the ground, evaporate into the air, become stored in lakes or reservoirs, or be extracted for agricultural or other human uses.

Infiltration - The flow of water from the ground surface into the ground. Once infiltrated, the water becomes soil moisture or groundwater.

Subsurface Flow - The flow of water underground, in aquifers. Subsurface water may return to the surface (e.g. as a spring or by being pumped) or eventually seep into the oceans. Water returns to the land surface at lower elevation than where it infiltrated, under the force of gravity or gravity induced pressures. Groundwater tends to move slowly, and is replenished slowly, so it can remain in aquifers for thousands of years.

Evaporation - The transformation of water from liquid to gas phases as it moves from the ground or bodies of water into the overlying atmosphere. The source of energy for evaporation is primarily solar radiation. Evaporation often implicitly includes transpiration from plants, though together they are specifically referred to as evapotranspiration.

Sublimation - The state change directly from solid water (snow or ice) to water vapor.

Condensation - The transformation of water vapor to liquid water droplets in the air, creating clouds and fog.

Transpiration The release of water vapor from plants and soil into the air. Water vapor is a gas that cannot be seen.

Carbon Cycle

Carbon moves from the atmosphere to plants. In the atmosphere, carbon is attached to oxygen as CO_2 . With the help of the Sun, through the process of photosynthesis, carbon dioxide is pulled from the air.

Carbon moves from plants to animals. Through food chains, the carbon that is in plants moves to the animals that eat them. Animals that eat other animals get the carbon from their food too.

Carbon moves from plants and animals to the ground. When plants and animals die, their bodies, wood and leaves decay bringing the carbon into the ground. Some becomes buried miles underground and will become fossil fuels in millions and millions of years.

Carbon moves from living things to the atmosphere. Each time you exhale, you are releasing carbon dioxide gas (CO_2) into the atmosphere. Animals and plants get rid of carbon dioxide gas through a process called respiration.

Carbon moves from fossil fuels to the atmosphere when fuels are burned. When humans burn fossil fuels to power factories, power plants, cars and trucks, most of the carbon quickly enters the atmosphere as carbon dioxide gas. Of the huge amount of carbon that is released from fuels, 3.3 billion tons enters the atmosphere and most of the rest becomes dissolved in seawater.

Carbon moves from the atmosphere to the oceans. The oceans, and other bodies of water, soak up some carbon from the atmosphere.

Nitrogen Cycle

Nitrogen is present in the environment in a wide variety of chemical forms including organic nitrogen, ammonium (NH_4^+), nitrate (NO_3^-), and nitrogen gas (N_2). The processes of the nitrogen cycle transform nitrogen from one chemical form to another. Many of the processes are carried out by microbes either to produce energy or to accumulate nitrogen in the form needed for growth.

Nitrogen fixation - Atmospheric nitrogen must be processed, or "fixed" to be used by plants. Some fixation occurs in lightning strikes, but most fixation is done by bacteria. These bacteria have the nitrogenase an enzyme that combines gaseous nitrogen with hydrogen to produce ammonia. It is then further converted by the bacteria to make their own organic compounds.

Conversion of N_2 (Gas) into Nitrate - The conversion of nitrogen (N_2) from the atmosphere into a form readily available to plants and hence to animals and humans is an important step in the nitrogen cycle, which distributes the supply of this essential nutrient. There are four ways to convert N_2 (atmospheric nitrogen gas) into more chemically reactive forms:

1. **Biological fixation:** some symbiotic bacteria (most often associated with leguminous plants) and some free-living bacteria are able to fix nitrogen as organic nitrogen.
2. **Industrial N-fixation:** Under great pressure, at a temperature of 600 C, and with the use of an iron catalyst, atmospheric nitrogen and hydrogen (usually derived from natural gas or petroleum) can be combined to form ammonia (NH_3).
3. **Combustion of fossil fuels:** automobile engines and thermal power plants, which release various nitrogen oxides (NO_x).

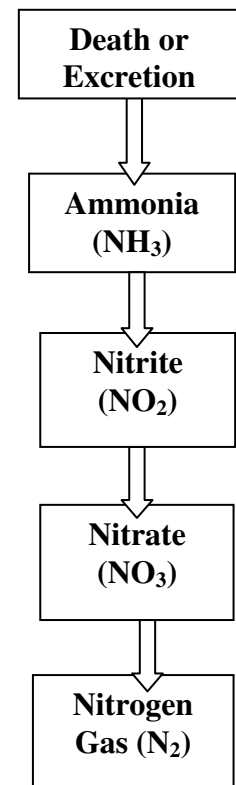
4. **Other processes:** In addition, the formation of NO from N_2 and O_2 due to photons and especially lightning, can fix nitrogen.

Ammonification - When a plant dies, an animal dies, or an animal expels waste, the initial form of nitrogen is organic. Bacteria, or in some cases, fungi, convert the organic nitrogen within the remains back into ammonium (NH_4^+), a process called ammonification or mineralization.

Nitrification - The conversion of ammonium to nitrate is performed primarily by soil-living bacteria and other nitrifying bacteria. The primary stage of nitrification, the oxidation of ammonium (NH_4^+) is performed by bacteria such as the Nitrosomonas species, which converts ammonia to nitrites (NO_2^-). Other bacterial species, such as the Nitrobacter, are responsible for the oxidation of the nitrites into nitrates (NO_3^-). It is important for the nitrites to be converted to nitrates because accumulated nitrites are toxic to plant life.

Denitrification - Denitrification is the reduction of nitrates back into the largely inert nitrogen gas (N_2). This process is performed by bacterial species such as Pseudomonas and Clostridium in anaerobic conditions. They use the nitrate as an electron acceptor in the place of oxygen during respiration. These facultatively anaerobic bacteria can also live in aerobic conditions.

Assimilation - Some plants get nitrogen from the soil, and by absorption of their roots in the form of either nitrate ions or ammonium ions. All nitrogen obtained by animals can be traced back to the eating of plants at some stage of the food chain. Animals, fungi, and other heterotrophic organisms absorb nitrogen as amino acids, nucleotides and other small organic molecules.



Human influences on the nitrogen cycle - As a result of extensive cultivation of legumes (particularly soy, alfalfa, and clover), the creation of chemical fertilizers, and pollution emitted by vehicles and industrial plants, human beings have more than doubled the annual transfer of nitrogen into biologically-available forms. N_2O (nitrous oxide) has risen in the atmosphere as a result of agricultural fertilization, biomass burning, cattle and feedlots, and other industrial sources. N_2O has deleterious effects in the stratosphere, where it breaks down and acts as a catalyst in the destruction of atmospheric ozone.